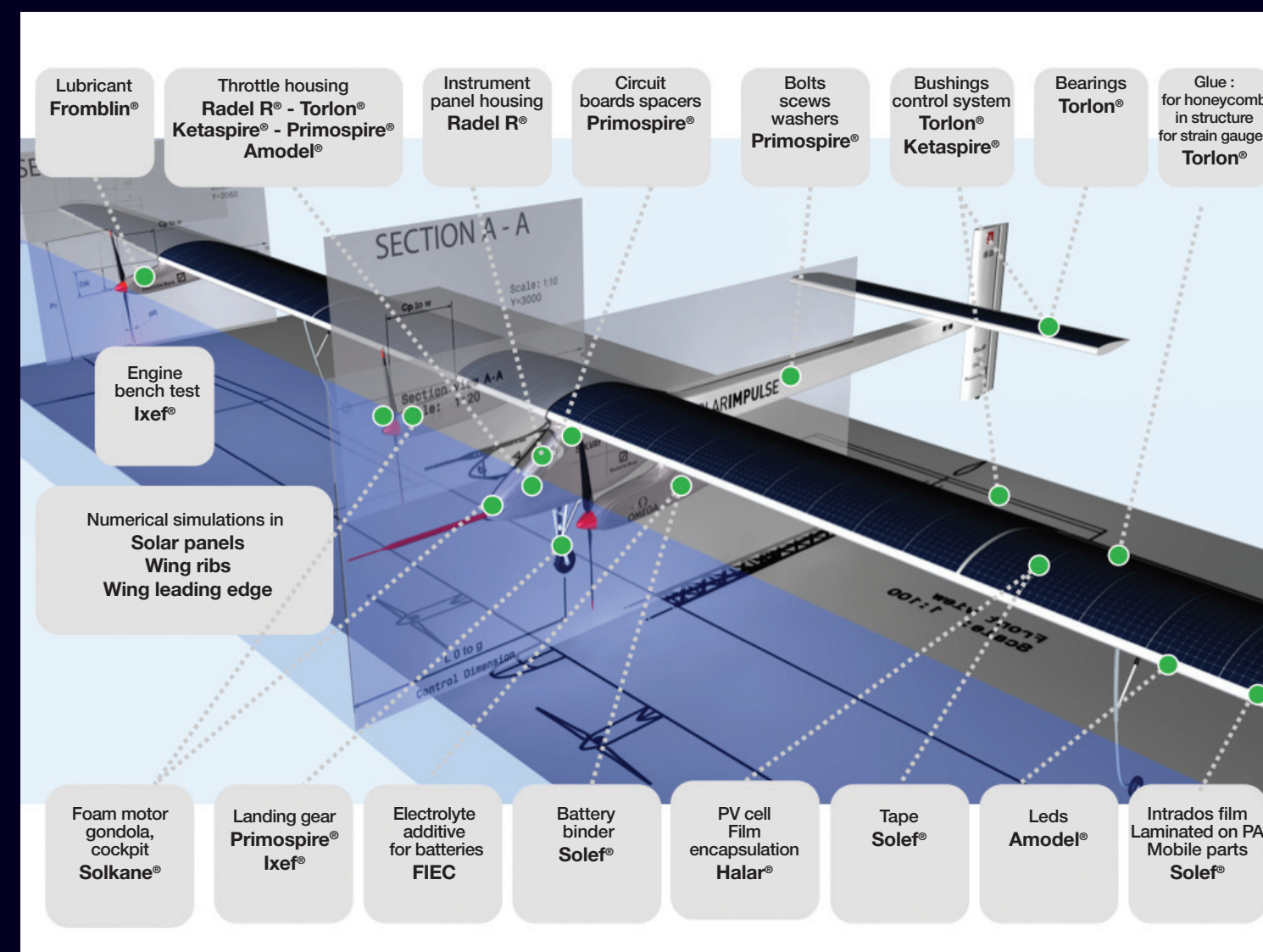


With this partnership, Solvay has taken up challenges pushing back the boundaries of present-day technological know-how. The partnership between Solvay and Solar Impulse reflects the Group's unshakable faith in personal commitment, the spirit of technological innovation and enterprise in response to the challenge of Sustainable Development.

The close relationship of Solvay with the Piccard family goes back three generations to the time when Auguste Piccard, Bertrand's grandfather, took part with Albert Einstein and Marie Curie in the "Conseils de Physique" created in 1911 by Ernest Solvay, the founder of the business.

Solvay's passion for humanity, science and technology - summarised, in fact, in the business motto "a Passion for Progress®" has shown itself once more in this partnership with Solar Impulse.



Solvay backs the «zero fuel» plane with chemical expertise Solar Impulse



Solar Impulse is the only solar plane in the world that can fly day and night with a pilot on board without using a drop of fossil fuel.

Solvay, which became the project's first main partner in 2004, has backed this magnificent challenge from the start, with the commitment of its engineers.

Solvay is on board the Solar Impulse with its know-how and its passion for progress, 11 products, around twenty applications, and a total of more than 6000 parts.

Solvay optimises the energy chain, the plane's structure, its overall weight, and the fluidity of its systems, and carries out numerical simulations.

Together at the controls

Two men, pioneers and innovators, both pilots, conceived the project and guaranteed the development of Solar Impulse. Bertrand Piccard, a psychiatrist and aeronaut, made the first ever non-stop round the world balloon flight. André Borschberg, an engineer and management sciences graduate, trained as a fighter pilot and professional aeroplane and helicopter pilot.

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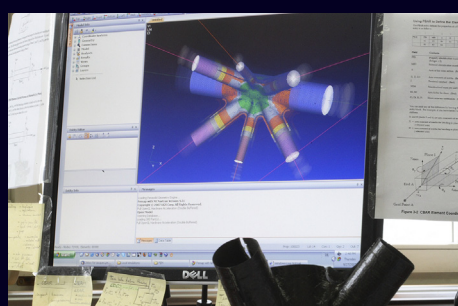
SOLARIMPULSE

AROUND THE WORLD IN A SOLAR AIRPLANE



SOLVAY

MAIN PARTNER



"The Solvay People"

A dozen researchers and engineers from our European laboratories (Germany, Belgium, Italy) - chemists and physicists - design and develop these innovative solutions on the basis of our advanced materials by pushing knowledge and performance to the limit.

Since it joined the Solar Impulse project as the first main partner in 2004 at the very beginning of the project, the Solvay chemicals group has always played an active part in this technological challenge. The firm has made its recognised scientific expertise and skills available to the project in order to contribute to producing solutions in the field of the development and production of innovative materials. These skills are just one example of the Group's contributions in the field of sustainable development by participating in the advent of alternative or renewable alternative energy sources.

Permanent challenges

Building and flying a plane propelled exclusively by solar energy immediately raises challenges.

The first of these is the energy available for propulsion.

Over a 24-hour period, a 1m² solar panel generates on average 40 watts, i.e. 250 times less than is contained in 1 litre of traditional fuel. As 40 watts is needed for approximately 8 kg to fly, the equation is as simple as it is inescapable - to fly a plane weighing 1600 kg, pilot included, you need 200 m² of photovoltaic cells to produce the necessary 8 KW.

And the second technological challenge appears - the overall weight of the plane.

Every component has had to be optimised and lightened to the maximum. The outstanding performance to weight ratio is the obsession underlying the whole process of design and construction of this solar plane. Solar Impulse would not exist without the contribution of the advanced materials developed by the chemicals company.

Solvay's contribution to the Solar Impulse project is based on research into innovative technical solutions and materials, the replication and simulation of their behaviour in extreme environments, and their technical evaluation in five areas.

The energy chain

A gain of 30% in specific energy efficiency.

Protection of the photovoltaic system.

Solar energy is captured by the silicon cells, assembled to form the upper surface of the wing and undergoing its stresses and deformations as well as all the attacks by external agents (temperature variations, solar radiation).

Fluorinated polymer based films present the best compromise for mechanical performance, radiation resistance, transparency and weight to "encapsulate" the photovoltaic cells.

PVDF Solef® and ECTFE Halar® polymers are used for this purpose (ultra-thin single layer films, laminated films, adhesive films).

Energy Storage

The electrical energy produced by the photovoltaic cells is stored in **the 400 kg specific high-energy lithium batteries**.

Solvay products and plastics contribute to the high performance of these batteries; PVDF Solef® is used for the manufacture of the electrodes and FIEC® (Monofluoroethylene carbonate) is used as electrolyte component.

Everyday uses

- > Solar panels
- > Computer and mobile phone batteries

The structure of the plane

Insulating foam for extreme temperatures +40°C to -60°C.

Of traditional spar/rib design, the structure of the plan uses materials with the best performance at minimum weight, in particular carbon fibre and foams.

Ultra-resistance mechanical parts

The wing spars (63 metres span) and rear stabilisers are **a honeycomb structure sandwiched between two layers of carbon fibre**. Torlon® Polyamide-imide is one of the key components of the honeycomb structure, giving outstanding mechanical performance over all.

Heat insulation

The cockpit and the 4 battery housings are made of polyurethane foam optimised in terms of density, mechanical strength and heat insulation between +40°C and -60°C.

Solvay's fluorinated solvent Solkane 365mfc®, used as polyurethane foaming agent, makes it possible to achieve this optimum.

Everyday uses

- > Internal fittings of planes
- > Home insulation

Lightening of the plane

An immediate gain of 650 grams on the control unit.

One way of making the plane lighter is, as far as possible, to replace every part of the assembly or construction, traditionally made of metal, with much lighter ultra-high performance polymers. These typically have densities of 1.4 to 1.8, to be compared with 7.9 for Iron, 4.5 for Titanium, and 2.7 for Aluminium.

Ultra-light material

Many parts of the instrument panel and control units, and moving parts such as bearings, axles, and hinges, are made of ultra-performing polymers. Polyphenylsulfone (Radel®), Polyamineimide (Torlon®), Polyarylamide (Ixef®), Polyphthalamide (Amodel®), and Polyetheretherketone (Ketaspire®) were used in the design of these components. Typically, the **60 parts** made solely for the power control **box saved 650 g in comparison with metal solutions**.

... and ultra resistant

Many plastic screw-nut-washer systems were needed to assemble the various parts of the plane's structure. Many of these were designed and made using the ultra polymer Polyphenylene (Primospire®).

Everyday uses

- > Overland transport
- > General public electronics

Systems fluidity (lubrication)

Efficient lubrication for -60°C.

One way of saving energy was **to provide continuous excellent lubrication of the rotating parts** in the wide range of operating temperatures, from +40°C to -60°C. This was achieved using Perfluoroether (Fomblin®).

Numerical simulations

The design and development stages of this plane called for sophisticated behaviour calculations by Finite Element Analysis (FEA).

Solvay has specific skills in "non linear digital simulations", the only approach that can predict the behaviour of deformable structures reliably and accurately.

Many decisive simulations have been produced in the field of materials behaviour (encapsulation of photovoltaic cells, use of epoxy glues) **and in that of the structure of the plane itself** (solar panels, wing ribs, wing leading edge).

5 times lighter
than a traditional glider